

WHAT IS CLAIMED IS:

1. An optical recording medium comprising a recording layer containing at least materials capable of carrying out read/write/erase operations through phase changes of said materials therein,

5 wherein:

said recording layer essentially consists of Ag, In, Sb and Te, with a proportion in atomic percent of a(Ag): b(In): c(Sb): d(Te), with  $0.1 \leq a \leq 7$ ,  $2 \leq b \leq 10$ ,  $64 \leq c \leq 92$  and  $5 \leq d \leq 26$ , provided that  $a + b + c + d \geq 97$ .

10 2. The optical recording medium according to claim 1, wherein:

said recording layer has a composition satisfying a relation of  $88 \leq c + d \leq 98$ .

15 3. An optical recording medium comprising a substrate, and contiguous layers formed on said substrate in order as follows, a first dielectric layer, a recording layer, a second dielectric layer, a metal/alloy layer, and an ultraviolet light curing resinous layer, wherein:

20 said recording layer essentially consists of phase change recording materials having a composition as claimed in claim 1.

4. The optical recording medium according to claim 3, wherein:

25 said first dielectric layer, recording layer, second dielectric layer and metal/alloy layer are each formed having a thickness ranging from 30 nm to 220 nm, 10 nm to 25 nm, 10 nm to 50 nm, and 70 nm to 250 nm, respectively.

30 5. The optical recording medium according to claim 4, wherein:

said metal/alloy layer essentially consists of Al and at least one kind of additive with a content ranging from 0.3 weight percent to 2.5 weight percent, said additive being selected from the group consisting of Ta, Ti, Cr and Si.

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6. The optical recording medium according to claim 4, wherein:

said metal/alloy layer essentially consists of Ag and at least one kind of additive with a content ranging from 0 to 4 weight percent, said additive being selected from the group consisting of Au, Pt, Pd, Ru, Ti and Cu.

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7. The optical recording medium according to claim 3, wherein:

said recording medium is rewritable at least once at a linear recording velocity ranging from 9 m/sec to 30 m/sec.

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8. An optical recording medium comprising a recording layer containing at least materials capable of carrying out read/write/erase operations through phase changes of said materials therein,

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wherein:

said recording layer essentially consists of Ag, In, Sb, Te and Ge, with a proportion in atomic percent of a(Ag): b(In): c(Sb): d(Te): e(Ge), with  $0.1 \leq a \leq 7$ ,  $2 \leq b \leq 10$ ,  $64 \leq c \leq 92$ ,  $5 \leq d \leq 26$  and  $0.3 \leq e \leq 3$ , provided that  $a + b + c + d + e \geq 97$ .

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9. The optical recording medium according to claim 8, wherein:

said recording layer has a composition satisfying a relation of  $88 \leq c + d \leq 98$ .

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10. An optical recording medium comprising a substrate, and contiguous layers formed on said substrate in order as follows, a first dielectric layer, a recording layer, a second dielectric layer, a metal/alloy layer, and an ultraviolet light curing resinous layer, wherein:

said recording layer essentially consists of phase change recording materials having a composition as claimed in claim 8.

11. The optical recording medium according to claim 10, wherein:

said first dielectric layer, recording layer, second dielectric layer and metal/alloy layer are each formed having a thickness ranging from 30 nm to 220 nm, 10 nm to 25 nm, 10 nm to 50 nm, and 70 nm to 250 nm, respectively.

12. The optical recording medium according to claim 11, wherein:

said metal layer essentially consists of Al and at least one kind of additive with a content ranging from 0.3 weight percent to 2.5 weight percent, said additive being selected from the group consisting of Ta, Ti, Cr and Si.

13. The optical recording medium according to claim 11, wherein:

said metal/alloy layer essentially consists of Ag and at least one kind of additive with a content ranging from 0 to 4 weight percent, said additive being selected from the group consisting of Au, Pt, Pd, Ru, Ti and Cu.

14. The optical recording medium according to claim 10,  
wherein:

said recording medium is rewritable at least once at a linear  
recording velocity ranging from 9 m/sec to 30 m/sec.

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15. A sputtering target for forming a recording layer, said  
recording layer being incorporated into an optical recording medium  
capable of carrying out read/write/erase operations through phase changes  
of materials therein,

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wherein:

said sputtering target essentially consists of Ag, In, Sb and Te,  
with a proportion in atomic percent of a(Ag): b(In): c(Sb): d(Te), with  $0.1 \leq a \leq 7$ ,  $2 \leq b \leq 10$ ,  $64 \leq c \leq 92$  and  $5 \leq d \leq 26$ , provided that  $a + b + c + d \geq 97$ .

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16. The sputtering target according to claim 15,  
wherein:

said sputtering target has a composition satisfying a relation of  
 $88 \leq c + d \leq 98$ .

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17. A sputtering target for forming a recording layer, said  
recording layer being incorporated into an optical recording medium  
capable of carrying out read/write/erase operations through phase changes  
of materials therein,

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wherein:

said sputtering target essentially consists of Ag, In, Sb, Te and  
Ge, with a proportion in atomic percent of a(Ag): b(In): c(Sb): d(Te):  
e(Ge), with  $0.1 \leq a \leq 7$ ,  $2 \leq b \leq 10$ ,  $64 \leq c \leq 92$ ,  $5 \leq d \leq 26$  and  $0.3 \leq e \leq 3$ ,  
provided that  $a + b + c + d + e \geq 97$ .

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18. The sputtering target according to claim 17,  
wherein:  
said sputtering target has a composition satisfying a relation of  
 $88 \leq c + d \leq 98$ .

19. A method for initializing a phase-change optical recording  
medium by irradiating said recording medium with a scanning beam spot  
emitted from a high power semiconductor laser device, said recording  
medium being capable of carrying out optically read/write/erase operations  
of information data onto said recording medium,  
wherein  
an energy density input by said beam spot is equal to, or less than,  
 $1000 \text{ J/m}^2$ .

20. An apparatus configured to perform at least an  
initialization operation onto a phase-change optical recording medium by  
irradiating said recording medium with a scanning beam spot emitted from  
a high power semiconductor laser device, said initialization operation  
including at least the steps as claimed in claim 19.

21. A rewritable phase-change optical recording medium, said  
recording medium being initialized at least by the steps as claimed in claim  
19.

22. The method according to claim 19,  
wherein a scanning speed of said beam spot is in a range of 3.5  
m/sec to 6.5 m/sec.

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23. An apparatus configured to perform at least an initialization operation onto a phase-change optical recording medium by irradiating said recording medium with a scanning beam spot emitted from a high power semiconductor laser device, said initialization operation including at least the steps as claimed in claim 22.

24. A rewritable phase-change optical recording medium, said recording medium being initialized at least by the steps as claimed in claim 22.

25. The method according to claim 19, wherein an intensity of the emission from said semiconductor laser device is equal to, or greater than, 330 mW.

26. An apparatus configured to perform at least an initialization operation onto a phase-change optical recording medium by irradiating said recording medium with a scanning beam spot emitted from a high power semiconductor laser device, said initialization operation including at least the steps as claimed in claim 25.

27. A rewritable phase-change optical recording medium, said recording medium being initialized at least by the steps as claimed in claim 25.

28. The method according to claim 19, wherein a width of an overlapped portion, which is formed as an overlap of irradiated portions of two neighboring irradiation tracks on said recording medium during two consecutive rotations of said recording medium in initializing steps, is equal to, or less than,  $0.5 W_r$ , where  $W_r$  is a width at half maximum of a spatial laser power distribution in a direction

perpendicular to a beam scanning direction.

29. An apparatus configured to perform at least an initialization operation onto a phase-change optical recording medium by irradiating said recording medium with a scanning beam spot emitted from a high power semiconductor laser device, said initialization operation including at least the steps as claimed in claim 28.

30. A rewritable phase-change optical recording medium, said recording medium being initialized at least by the steps as claimed in claim 28.

31. The method according to claim 19,  
wherein  
an energy density input by said beam spot during one period of through scan is equal to, or greater than,  $600 \text{ J/m}^2$ .

32. An apparatus configured to perform at least an initialization operation onto a phase-change optical recording medium by irradiating said recording medium with a scanning beam spot emitted from a high power semiconductor laser device, said initialization operation including at least the steps as claimed in claim 31.

33. A rewritable phase-change optical recording medium, said recording medium being initialized at least by the steps as claimed in claim 31.

34. The method according to claim 31,  
wherein a scanning speed of said beam spot is in a range of  $3.5 \text{ m/sec}$  to  $6.5 \text{ m/sec}$ .

35. An apparatus configured to perform at least an initialization operation onto a phase-change optical recording medium by irradiating said recording medium with a scanning beam spot emitted from a high power semiconductor laser device, said initialization operation including at least the steps as claimed in claim 34.

36. A rewritable phase-change optical recording medium, said recording medium being initialized at least by the steps as claimed in claim 34.

37. The method according to claim 31, wherein an intensity of the emission from said semiconductor laser device is equal to, or greater than, 330 mW.

38. An apparatus configured to perform at least an initialization operation onto a phase-change optical recording medium by irradiating said recording medium with a scanning beam spot emitted from a high power semiconductor laser device, said initialization operation including at least the steps as claimed in claim 37.

39. A rewritable phase-change optical recording medium, said recording medium being initialized at least by the steps as claimed in claim 37.

40. The method according to claim 31, wherein a width of an overlapped portion, which is formed as an overlap of irradiated portions of two neighboring irradiation tracks on said recording medium during two consecutive rotations of said recording medium in initializing steps, is equal to, or less than,  $0.5 W_r$ , where  $W_r$  is



a width at half maximum of a spatial laser power distribution in a direction perpendicular a scanning direction.

41. An apparatus configured to perform at least an  
5 initialization operation onto a phase-change optical recording medium by irradiating said recording medium with a scanning beam spot emitted from a high power semiconductor laser device, said initialization operation including at least the steps as claimed in claim 40.

42. A rewritable phase-change optical recording medium, said  
10 recording medium being initialized at least by the steps as claimed in claim 40.

43. A method for selecting an optimum recording power to  
15 suitably carry out read/write/erase operations of information data on a rewritable phase-change optical recording medium through phase changes induced in a recording layer included in said recording medium by laser beam irradiation, said recording layer essentially consisting of Ag, In, Sb and Te elements,

20 comprising the steps of:

writing a series of information data, as test recording runs, with  
recording power of laser beam consecutively varied in a range of 15 mW to 18 mW to thereby generate a recorded pattern including low and high  
reflective portions;

25 reading out signals from said low and high reflective portions on said recording medium to obtain recorded signal amplitude,  $m$ , corresponding to said recording power,  $P$ ;

calculating a normalized gradient,  $g(P)$ , using an equation,

$$g(P) = (m/\Delta m)/(P/\Delta P),$$

30 where  $\Delta P$  is an infinitesimal change in the vicinity of  $P$ , and  $\Delta m$  is an

infinitesimal change in the vicinity of  $P_i$ ;

determining an optimum recording power, after judging adequacy of the magnitude of said recording power based on thus calculated normalized gradient,  $g(P)$ ;

5 selecting a specific number,  $S$ , from the numbers in the range of 0.2 to 2.0 based on said calculated normalized gradient,  $g(P)$ ;

obtaining a value of said recording power,  $P_s$ , which coincide with said specific number,  $S$ , presently selected;

10 selecting a specific number,  $R$ , based on the obtained recording power,  $P_s$ , from the numbers in the range of 1.0 to 1.7; and

multiplying said recording power,  $P_s$ , by said specific number,  $R$ , to obtain an optimum recording power,  $P_o$ .

44. A phase-change optical recording medium comprising a  
15 recording layer, wherein said recording layer contains information recorded in advance therein corresponding to said  $S$  and  $R$  values specified by said method as claimed in claim 43.

45. The phase-change optical recording medium according to  
20 claim 44, wherein  $1.2 \leq S \leq 1.4$ , and  $1.1 \leq R \leq 1.3$ .

46. The phase-change optical recording medium according to  
claim 44, wherein said recording medium is recordable at a recording  
velocity ranging from 4.8 m/sec to 14.0 m/sec.

25 47. A phase-change optical recording medium comprising a recording layer, wherein said recording layer contains information regarding a  $P_i$  value recorded in advance therein, said  $P_i$  value corresponding to said optimum recording power,  $P_o$ , specified by said  
30 method as claimed in claim 43.

48. The phase-change optical recording medium according to claim 47, wherein said recording medium is recordable at a recording velocity ranging from 4.8 m/sec to 14.0 m/sec.